Remarks

Entry of these amendments, reconsideration of the application and allowance of all claims are respectfully requested. Claims 1-41 are currently pending with claims 18-40 having been withdrawn from consideration, claims 1-12 and 15-17 rejected, and claims 13 and 14 objected to as being dependent upon a rejected base claim. Claim 41 is a new claim combining the subject matter of claims 1, 2 & 3.

As required by the Examiner, Applicants respectfully affirm their election of the group I, claims 1-17. Applicants traverse the election requirement, however, and request reconsideration thereof.

One of the requirements for a restriction to be proper is that there must be a burden on the Patent Office to examine the claims together. If there is no burden then restriction, regardless of the content of the claims, is not proper (see M.P.E.P. §803). In this case, because of the closeness of the subject matter claimed between the different groups, applicants respectfully submit that there would be little additional burden on the Examiner to examine the Group II claims 18-40 in one application with the Group I claims 1-17. Accordingly, applicants request reconsideration of the Restriction Requirement.

With respect to the objections to the drawings, amended informal drawing figures 1E, 2D, 3B, 3D & 4 are submitted on drawing sheet nos. 2/10, 4/10, 6/10, 7/10 and 9/10, respectively, submitted herewith. The proposed changes,

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suggested by the Examiner, are shown in red in accordance with 37 C.F.R. 1.121(d). Withdrawal of the objections to the drawings is therefore respectfully requested. Formal drawings in compliance with § 1.84 including the changes noted will be submitted subsequent to approval by the Examiner.

In accordance with 37 C.F.R. 1.121(b)(1)(iii), a marked-up version of the amended specification paragraphs is provided on one or more pages separate from the amendment. These pages are appended at the end of the Response.

In the specification, the serial numbers of the co-filed applications have been added at page 1 of the specification, and applicants' docket numbers have accordingly been deleted.

A marked-up version of claim 41 is unnecessary pursuant to 37 C.F.R. 1.121(c) since the claim comprises a new claim.

With respect to the claims, applicants gratefully acknowledge the Examiner's indication of allowability of claims 13 and 14, that is, if rewritten in independent form including all the limitations of the base claim and any intervening claims. These claims have not been rewritten herein, however, since all claims are believed allowable for the reasons set forth below.

Claims 1,2, 6-12 and 15-17 are initially rejected under 35 U.S.C. § 103(a) as allegedly being obvious over United States Patent No. 5,841,193 to Eichelberger ("Eichelberger")

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in view of United States Patent No. 5,249,101 to Frey et al. ("Frey"). This rejection is respectfully, but most strenuously, traversed.

Applicants' claim 1 is directed in part to a structure for absorbing stress between a first electrical structure and a second electrical structure. The structure comprises a dielectric material disposed on at least one of a first electrical structure and a second electrical structure. The dielectric material comprises a low modulus material which has a high ultimate elongation property (LMHE). The LMHE dielectric material functions to absorb stress between the first electrical structure and the second electrical structure resulting from the first the second electrical structures having different coefficients of thermal expansion.

Applicants have discovered that when a conventional high modulus dielectric is used (instead of a low modulus high elongation dielectric in accordance with the principles of the present invention), the dielectric rigidly binds the conductors to the circuit board (i.e., the first electrical structure is rigidly bound to the second electrical structure). When displacement between the first and second electrical structures due to different coefficients of thermal expansion occurs, the conductors move with the circuit board. Further, there is no conventional requirement for the conductor to stretch to absorb the displacement. Instead the bump and solder interconnect is normally required to absorb the strain. Applicants believe that this unduly strains the solder interconnect and limits

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the reliability of the structure. See Specification, page 16, line 28 to page 17, line 4.

Applicants disclose that in accordance with the present invention a dielectric with a high elongation property allows stretching to occur, (thereby accommodating thermal expansion mismatch between the first electrical structure (e.g. circuit board) and the second electrical structure (e.g. an associated IC chip in a module)), while its low modulus characteristic puts little stress on the solder interconnection. See Specification, page 24, lines 4-11. Thus, applicants disclose and claim herein using a dielectric material which comprises a low modulus material having a high ultimate elongation property, i.e., a LMHE dielectric.

With respect to the rejection, Applicants submit that a valid obvious rejection requires that the prior art patents, when combined, teach or suggest all of the claimed elements. In the instant application, however, there are features of Applicants' claims which are not taught or suggested by the applied patents, either individually or in combination.

As the Examiner recognizes at page 4 of the Office Action, Eichelberger does not show a dielectric material comprising a low modulus material having a high ultimate elongation property. Further, it is respectfully submitted that Eichelberger fails to disclose or suggest the existence of a low modulus high elongation dielectric material between a first electrical structure and a second electrical structure as recited in applicants' claim 1.

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Applicants respectfully submit that Frey fails to cure the above-noted deficiencies of Eichelberger when the two patents are combined as proposed in the Office Action. Specifically, Frey fails to disclose or suggest, at least, a low modulus, high elongation dielectric material. Moreover, Frey fails to disclose or suggest a low modulus, high elongation dielectric material between a first electrical structure and a second electrical structure as recited in claim 1 since Frey fails to disclose or suggest the existence of a second electrical structure above the dielectric described therein.

Initially, applicants traverse the characterization in the Office Action that the dielectric material of Frey comprises a low modulus high elongation (LMHE) material. Frey does teach a material comprising a low modulus; however, the material does not also have a high elongation property. As applicants carefully describe in their application and recite in the pending claims, the dielectric material in the present invention should have both a low modulus property and a high elongation characteristic in order to absorb stress between the two electrical structures recited.

Frey discloses a dielectric used as a protective coating which serves to protect circuitry from mechanical environmental hazards (column 4, lines 53-54). The coating of Frey is dispensed onto the circuitized surface and flows over the surface to cover exposed circuitry where it comes into contact with an encapsulant encapsulating the solder balls (Frey, column 4, lines 55-61). Since there is no

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second metal layer over the dielectric, there is also no need or requirement for the dielectric of Frey to have an elongation of more than the elongation of the circuit board to which it is applied.

Applicants respectfully submit that an elongation of a typical FR4 circuit board using a typical temperature range of 100 degrees Celsius is about 1 mil per inch. (See applicants' Specification, page 3, line 32 to page 4, line 4). This would thus be a requirement of only about 0.1 percent elongation, which is well below the exemplary limit of "greater than 20 %" disclosed in applicants' Specification, at page 24, lines 26-27, as a "high elongation" material in accordance with the principles of the present invention. A Declaration to this effect can be provided should the Examiner request. Therefore, there is no teaching or suggestion that the coating disclosed in Frey can stretch to the degree recited by applicants. Accordingly, applicants respectfully submit that Frey fails to disclose or suggest a dielectric material comprising a low modulus material which has a high ultimate elongation property.

The Office Action appears to imply that because the dielectric of Frey withstands cycling tests without exhibiting any internal cracks or interfacial cracks or delamination, it must comprise a LMHE material as recited by applicants. This conclusion is respectfully traversed. Whether or not the material exhibits internal cracks or interfacial cracks or delamination during testing is less a function of the elongation of the material than it is

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whether there is expansion matching with the underlying structure. Specifically, it is not necessary to have a material with a high elongation to accomplish the characterization of a dielectric at column 3, lines 13-22 & 49-61 of Frey. Therefore, applicants respectfully submit that there is no suggestion or implication in Frey that the dielectric described therein should or does comprise a high elongation dielectric.

Further, as briefly noted above, applicants submit that there is no teaching or suggestion in Frey that the dielectric coating disclosed be disposed between a first electrical structure and a second structure as recited by applicants. In view of this, applicants submit that the dielectric coating of Frey does not function to absorb stresses between a first and second electrical structure as recited by applicants in claim 1. Again, since there is no electrical structure over the dielectric coating of Frey, Frey does not require the coating to have an elongation greater than an elongation of the circuitized surface to which it is applied.

For all of the above reasons, applicants respectfully submit that neither Eichelberger nor Frey, alone or in combination, teach or suggest a dielectric material comprising a low modulus, high elongation dielectric, nor the disposition of such a dielectric material between a first electrical structure and a second electrical structure for absorbing stresses therebetween. Accordingly, applicants respectfully request reconsideration and withdrawal of the obviousness rejection to claim 1 based

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thereon. The dependent claims are believed allowable for the same reasons as independent claim 1, as well as for their own additional characterizations.

Claims 1 & 3-5 also stand rejected under 35 U.S.C. § 103(a) as allegedly being obvious over Eichelberger in view of United States Patent No. 5,903,046 to Brooks et al. ("Brooks"). This rejection is respectfully, but most strenuously, traversed.

As stated above, Eichelberger fails to disclose or suggest, at least, a dielectric material comprising a low modulus material which has a high ultimate elongation property as recited by applicants.

Applicants respectfully submit that Brooks fails to cure this deficiency. Specifically, Brooks fails to disclose or suggest at least a low modulus, high elongation dielectric material, notwithstanding the characterization otherwise in the Office Action.

Brooks discloses a cured ester coating material having a tensile modulus in the range of about 1 to about 5 Gpa (Brooks, Col. 3, lines 44-45), which equals about 140,000 psi to 700,000 psi. Applicants respectfully submit that this modulus taught by Brooks is much greater than the exemplary limit of "less than 50,000 psi" disclosed in applicants' Specification at page 24, lines 26-27 as a "low modulus" material in accordance with the principles of the present invention.

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Further, not only does the material of Brooks not fall within applicants' definition of a "low modulus" material as used in the present application, applicants respectfully submit that use of the Brooks material in a structure such as recited by applicants would place excessive strain on the solder bumps/pads, thereby causing fatigue failure after a short number of thermal cycles. This is because the tensile modulus of the material taught by Brooks is in the range of 140,000-700,000 psi, which is significantly greater than applicants' low modulus material.

Since neither Eichelberger nor Brooks, alone or in combination, teach or suggest applicants' recited low modulus, high elongation dielectric material (as the material is defined in the present application), applicants request reconsideration and withdrawal of the obviousness rejection to claim 1 based thereon. Claims 3-5 are dependent upon claim 1, and are believed allowable for the same reasons as claim 1, as well as for their own additional characterizations.

To summarize, applicants submit that Eichelberger, Frey and Brooks each fail to suggest or imply the use of a dielectric material as recited by applicants in claim 1, and in the particular structure recited. For example, applicants recite that the dielectric material comprises a low modulus, high elongation dielectric (LMHE) material which absorbs stresses between a first electrical structure and a second electrical structure having different coefficients of thermal expansion. Neither the Frey nor Brooks dielectric materials are capable of meeting this

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characterization of applicants' low modulus high elongation dielectric material. In the case of Frey, the elongation property of the material is insufficient, while in the case of Brooks, the modulus property of the material is insufficient to accomplish applicants' recited function. Further, applicants define what comprises a "low modulus" and what comprises a "high elongation" material in the application, and in new claim 41. Neither of the dielectrics described in Frey and Brooks meet this definition.

In view of the above, allowance of all claims presented herewith is respectfully requested. If, however, any issue remains unresolved, the Examiner is invited to telephone applicant's undersigned representative to further discuss the application.

Respectfully submitted,

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Dated: December 18, 2001

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